SUSTAINABLE DEVELOPMENT ASSESSMENT TOOLS DEDICATED TO TERRITORIAL COLLECTIVITIES: GDF SUEZ RESEARCH AND INNOVATION DIVISION EXPERTISE

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Summary: This paper presents in a first part GDF SUEZ Research and Innovation Division works on different sustainable development assessment tools (especially Material and Energy Flow Analysis (MEFA), Life Cycle Assessment (LCA), Carbon Balance and Ecological Footprint). The following part is focused on a Material and Energy Flow Analysis Project on the scale of a city : the example of Lille.

Keywords: Sustainable development, assessment tools, material and energy flow analysis, territorial ecology

Sustainable development assessment tools dedicated to territorial collectivities : GDF SUEZ Research and Innovation Division expertise

1. GDF SUEZ RESEARCH AND INNOVATION EXPERTISE ON SUSTAINABLE DEVELOPMENT ASSESSMENT TOOLS

GDF SUEZ Research and Innovation Division has been working on different sustainable development assessment tools for many years, especially Material and Energy Flow Analysis (MEFA), Life Cycle Assessment (LCA), Carbon Balance and Ecological Footprint. Its role is first to identify and analyse the most interesting tools which are available, second to qualify them and to contribute to the development of innovative methods. Its aim is to evaluate and improve GDF SUEZ systems (energy generation, transport, supply…) as well as its customers systems (industrial corporations). It is also an opportunity for GDF SUEZ to support local authorities in their sustainable development projects.

1.1 Life Cycle Assessment : a very comprehensive tool, taking into account the environmental impacts as a whole

Life cycle assessment is a tool to assess the potential environmental impacts (greenhouse effect, acidification, resource depletion…) of products systems or services at all stages in their life cycle, from extraction of resources, through the production and use of the product, to reuse, recycling or final disposal. The procedures of life cycle assessment are part of the ISO 14000 environmental management standards : in ISO 14040:2006 and 14044:2006. This tool is usually applied to products or services but can also be adapted to territorial collectivities, in order to assess the impact of buildings or city districts [Popovici E. (2006)].
GDF SUEZ Research and Innovation Division is involved in various LCA projects such as the assessment of renewable energies (biogas) [Wenisch S. *et al*. (2007)] and buildings. GDF SUEZ Research and Innovation Division is also involved in the life cycle assessment for the whole European gas chain (GDF SUEZ Research and Innovation Division is leading a working group on life cycle assessment for Marcogaz, the Technical Association of the European Natural Gas Industry).

1.2 Material and Energy Flow Analysis : an innovative tool dedicated to territorial or industrial ecology projects

Material and Energy Flow Analysis is a tool to count the flows that enter or get out of a territory (defined by its boundary) by type of activities (industry, transport, service, household) and by type of flows (energy, water, building materials, plastics, metals, textile, paper and board, wood and foodstuffs). This is an useful tool for territorial or industrial ecology projects aiming at optimizing resource use and resource efficiency at a local level.
GDF SUEZ Research and Innovation Division recent work is for example the development of an innovative Material and Energy Flow Analysis tool on the scale of a city, tested on Lille City (see part 2 below). GDF SUEZ is also involved in industrial ecology projects through its participation to ECOPAL association (the first association dedicated to industrial ecology in France) and DK6 power plant in Dunkirk (a power plant that burns steelworks gases with natural gas).

1.3 Ecological footprint : a tool dedicated to population awareness

Ecological footprint analysis is a measure of human demand on the Earth's ecosystems and natural resources. It compares human consumption of natural resources (ecological footprint) with planet Earth's ecological capacity to regenerate them (biocapacity). Using this assessment, it is possible to estimate how many planet Earths it would take to support humanity if everybody lived a given lifestyle. Figure 1 below compares ecological footprint with total biocapacity.
As an example, GDF SUEZ Research and Innovation Division calculated last year the ecological footprint of a tertiary building in the suburb of Paris.

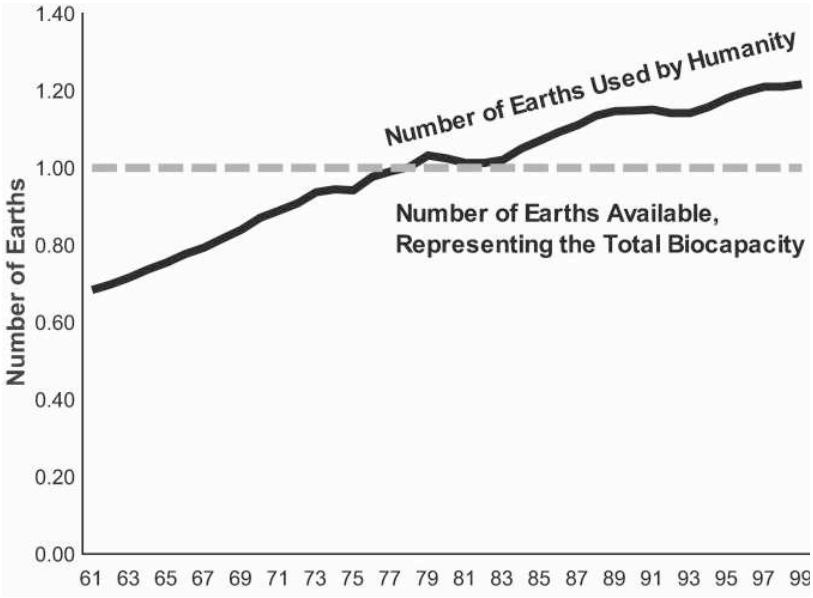

Figure 1 : Ecological footprint compared to total biocapacity [Wackernagel M. et al. (2002)]

1.4 Carbon Balance : a focus on greenhouse gases

Carbon balance (Bilan Carbone ®) is a tool proposed by ADEME (the French Environment and Energy Management Agency) in 2002-2003. This tool aims at giving an estimate for any greenhouse gas emission linked to a given activity whether these emissions physically happen within the boundaries of the activity or not. Results are expressed in ton of carbon equivalent. Two different versions exist : a version dedicated to industrial or office activities (2003-2004) and a newer version dedicated to local authorities (2007). GDF SUEZ Research and Innovation Division uses more particularly Bilan Carbone ® emission factors in its MEFA projects.

2. MATERIAL AND ENERGY FLOW ANALYSIS PROJECT ON THE SCALE OF A CITY : THE EXAMPLE OF LILLE CITY

2.1 Strong expectations on local authorities to include sustainable development into their policies

Sustainable development awareness of local authorities is increasing. New environmental projects are launched everyday (local Agenda 21, sustainable city districts, industrial ecology initiatives, renewable energy projects, territorial climate plans…), contributing to an obvious need for sustainable development assessment tools.

2.2 An innovative project designed for Lille City, requiring methodological developments

GDF SUEZ Research and Innovation Division, in partnership with Lille City and Auxilia Association, decided to initiate an ambitious territorial ecology project based on a Material and Energy Flow Analysis (MEFA). This R&D project (June 2005 – December 2007) was launched thanks to the strong political support from Lille City and the involvement of key actors such as the Regional Authority (Région Nord Pas-de-Calais), the French Agency for Environment and Energy Management (ADEME) and the Water Agency Artois Picardie.
The objectives of the project were to count the flows that enter or get out of Lille City and two smaller cities associated to Lille (Lomme and Hellemmes), to optimize resource use and resource efficiency at a local level and to involve local stakeholders (local chambers, urban development agencies, businesses, associations…).

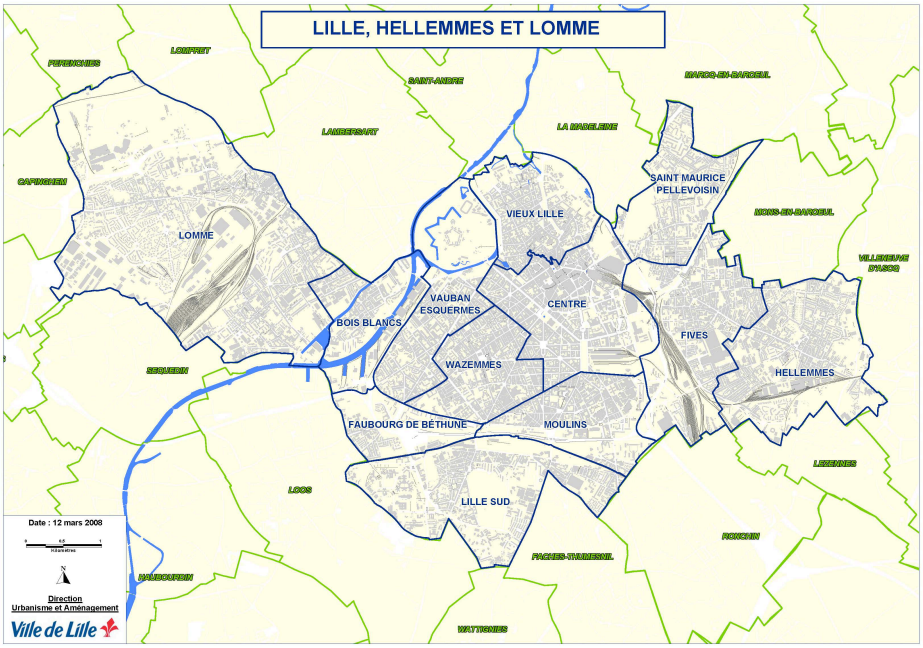

Figure 2 : Studied territory : Cities of Lille, Lomme and Hellemmes (35 km² and 226 800 inhabitants)

2.3 EUROSTAT : a European reference methodology for MEFA, that had to be adapted to local level

The reference methodology selected for the Lille MEFA project is proposed by EUROSTAT (Statistical Office of the European Communities) in its methodological guide published in 2001 [EUROSTAT (2001)]. This guide offers methodological guidance and practical suggestions to establish national material flow account (MFA) and material balances. This methodology (presented in figure 3 below) is quite simple (only four types of inputs and outputs are considered) and can be adapted depending on the context.
As the methodology proposed by EUROSTAT is dedicated to national levels, the research team proposed an adaptation to the local level.
A simplified methodology adapted to Lille City was developed that could be in the future transposed onto other territories.
Such tools for data collection and analysis have undergone very little development at the local level. This is mainly true in France, where these initiatives are marginal and pioneering. There is only one another project of this type in France at the moment : a project conducted on the Ile-de-France region by the French University Paris 8 [BARLES S. (2007)].

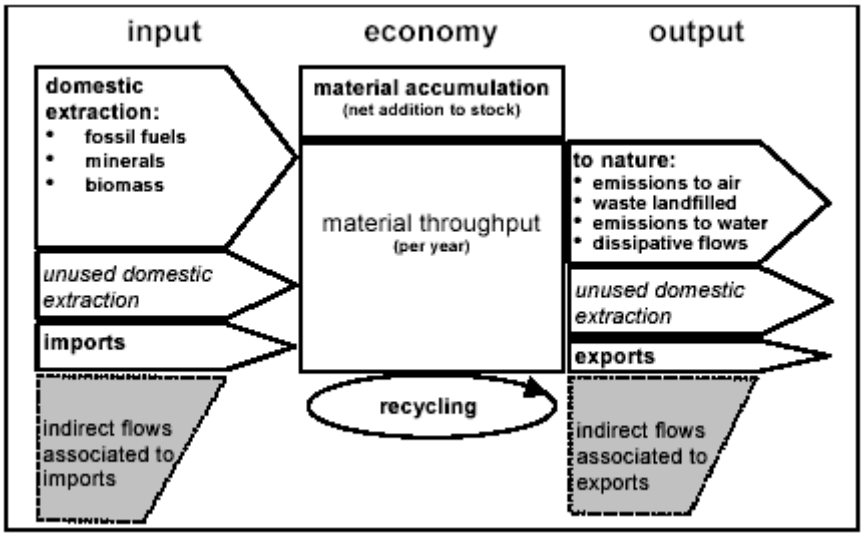

Figure 3. Economy-wide material balance scheme [EUROSTAT (2001)]

2.4 Main results : MEFA for nine type of flows gives the picture of the consumption dependence of Lille City

The flows included in this study are : energy, water, building materials, plastics, metals, textile, paper and board, wood and foodstuffs.
As an example, the figure 4 below presents the energy balance scheme of Lille City for the year 2005. Energy flows considered are : fossil fuels (natural gas, oil and coal), renewable energies (biomass, solar power…) and electricity (energy carrier).

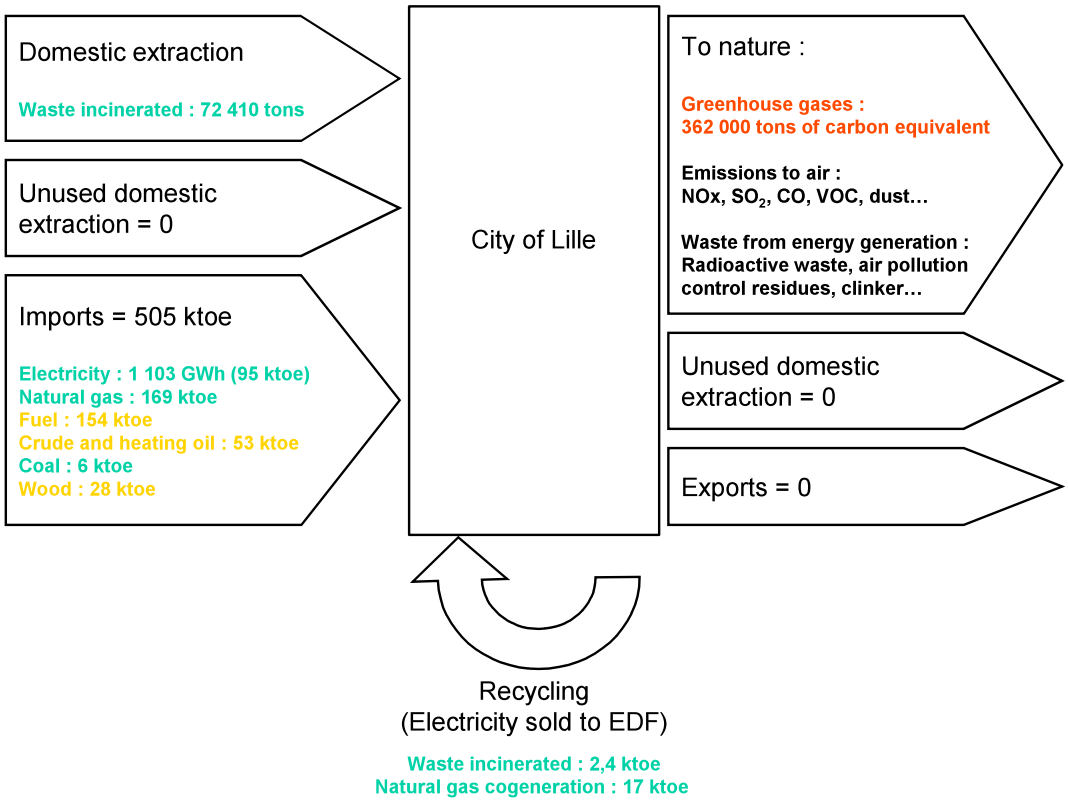

Figure 4 : Energy balance scheme, year 2005 (EUROSTAT representation)

The energy balance scheme for Lille City shows an energy consumption (sum of imports and recycling) of 524 ktoe[1]. It represents a consumption of 2.3 toe per inhabitant, slightly low compared to the French average : 2.6 toe [Observatoire de l'Energie (2006)].
The results highlight a very small proportion of energy produced by the city (less than 4%). Most of this is produced by energy recovery from waste incineration or electricity production by cogeneration power plants fuelled with natural gas.
The outputs considered in this energy balance scheme are air emissions (NOx, SO_2, CO, VOC, dust…), waste and greenhouse gases. The latter has been quantified using emission factors proposed by the French Agency for Environment and Energy Management in its Bilan Carbone ® methodology [ADEME (2006)].
Recommendations for future energy projects focus on increasing local energy generation (energy recovery from waste incineration, electricity production by CHP plants (fuelled with natural gas or wood), district heating and renewable energy) and energy savings (reducing transport).

2.5 Recommendations to optimize resources consumption oriented Lille City for future projects

Results of this work support Lille City in managing the territory resources on a better way and in implementing its sustainable development policy.
Examples of projects are the creation of new fields of recycling wastes (textile as an insulating material) and improvement of recycling building materials by encouraging a building demolition policy.

[1] toe : ton of oil equivalent

2.6 Lessons for future sustainability assessment projects with local authorities

Key success factors of this project are the strong political support of Lille City and the involvement of local stakeholders (local chambers, urban development agencies, businesses, associations…) as well as flow data collection : the research team met difficulties in obtaining accurate flow mass balances in some cases (foodstuffs, paper and board…).

Conclusion

GDF SUEZ Research and Innovation Division expertise on sustainable development assessment tools is an opportunity for the recently created Group GDF SUEZ to support local authorities in their sustainable development projects.
GDF SUEZ Research and Innovation Division future works will contribute to develop new hybrid tools dedicated to different types of territory (cities, regions, city districts, industrial or business park…) that could combine the advantages of the existing tools, especially MEFA, ecological footprint and carbon balance, and also the advantages of new LCA tools dedicated to buildings and city districts which are under development at the moment.

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